

other star by its attractive powers generated the whole of the comet's velocity. And as there is no limit to the application of such considerations, there seems no other way of explaining the interstellar velocities of the comets which have hyperbolic orbits, than by tracing back their course to the moment when their substance was ejected from some star with a velocity exceeding, by many miles per second, that with which a body would reach that star if attracted from an infinite distance by the star's sole influence. Granted that hyperbolic orbits exist, it is unquestionable that they are not *due* to the stellar attractions, however perfectly the motion of a comet in such an orbit corresponds, as we know, with the theory of gravitation.\*

It would follow, if meteors or some meteors were star-expelled bodies, that their constitution, when examined microscopically or under chemical analysis, would exhibit some traces of their origin. In Part II. of this paper I propose to consider the very striking evidence we have on this point. I shall touch also on some other evidence in favour of the theory here dealt with—a theory which, startling as it appears, seems yet to accord, better than any other, with what is at present known respecting the corona.

*On the Orbits of the Revolving Double Stars  $\zeta$  Herculis and  $\zeta$  Cancri.* By W. E. Plummer, of Mr. Bishop's Observatory, Twickenham.

(Communicated by G. Bishop, Esq.)

### $\zeta$ Herculis.

Though various attempts have been made to determine the elements of the orbit in which this short-period binary performs its revolution, none represented with precision the angle of position when the star had become observable after the close approach of the components in 1866. Mr. Breen's, the most recently published orbit with which I am acquainted, exhibited such large discrepancies between the observed and computed positions, that it was evident that his elements might be improved with the information afforded by more recent observations. By means of equations of condition founded upon the observations of

two globes under their sole influence respectively. Let the radius of one be  $R$ , and its mean specific gravity  $C_R$ ; the radius of the other  $r$  and its mean specific gravity  $C_r$ ; the respective maximum velocities being  $V$  and  $v$ . Then  $\frac{V^2}{v^2} = \frac{R^2 C_R}{r^2 C_r}$ . The same relation holds if  $V$  and  $v$  be the velocities acquired in

falling from heights  $H$  and  $h$  respectively, where  $\frac{H}{h} = \frac{R}{r}$ . ]

\* We may suppose, indeed, that in some few instances (*i.e.*, relatively few), planets like *Jupiter* and *Saturn* may have given to parabolic cometic orbits a hyperbolic figure; but it seems scarcely admissible to suppose that this is otherwise than exceptional.

the best observers from 1782 to 1869, I have determined the elements which follow.

The observations of this long period of ninety years are fairly represented, but I have thought it useless to exhibit a long list of compared observations, and have computed a short Ephemeris for the next five years, with which comparisons may be instituted and observers decide upon the merit of the orbit.

Date of the Periastron	1866.241
Period of the Revolution	36.606 years
Longitude of the Node	27° 0' 4
Longitude of the Periastron	291 49° 0
Inclination	50 14° 1
Excentricity = $e = 0.55110, \phi = 33 26.5$	
Mean Motion in minutes	[2.77090]
Mean Distance	1".374

### $\zeta$ *Cancri.*

I have also made a new determination of the orbit of  $\zeta$  *Cancri* in the same manner as that of  $\zeta$  *Herculis*, employing the elements given by Dr. Winnecke. The observations of the pair extend over a period of nearly ninety years, and all the observations that have been compared with the positions computed from the elements agree very closely. The observed distances, however, present considerable discrepancies, to be accounted for perhaps by the general closeness of the stars. Observers of acknowledged repute differ considerably in their estimation of distance; those measures have been employed which were taken when the stars were considerably separated as being probably the more exact.

Periastron Passage	1872.44
Period of Revolution	58.23 years
Longitude of the Node	15° 37' 4
Longitude of the Periastron	171 46.8
Inclination	36 14.4
Excentricity $e = 0.30230$ , $\phi =$	17 35.8
Mean Motion in minutes	[2.56930]
Mean Distance	0".908

The computed values are as follows :—

$\zeta$ Herculis.			$\zeta$ Cancri.		
Date.	Angle of Position.	Distance.	Date.	Angle of Position.	Distance.
1870° 0	196° 50'	1° 04"	1870° 0	196° 44'	0° 65"
1870° 5	192° 31'	1° 09"	1870° 5	192° 6'	0° 64"
1871° 0	188° 30'	1° 13"	1871° 0	187° 22'	0° 64"
1871° 5	184° 45'	1° 17"	1871° 5	182° 30'	0° 63"

	ζ Herculis.		ζ Cancri.		
Date.	Angle of Position.	Distance.	Date.	Angle of Position.	Distance.
1872.0	181 10'	1.20	1872.0	177 30'	0.62
1872.5	177 46	1.22	1872.5	172 23	0.61
1873.0	174 31	1.24	1873.0	167 8	0.60
1873.5	171 21	1.26	1873.5	161 43	0.59
1874.0	168 12	1.27	1874.0	156 5	0.58
1874.5	165 9	1.28	1874.5	150 13	0.57
1875.0	162 12	1.29	1875.0	144 7	0.56

*On the Shallowness of the Real Solar Atmosphere.*

By Richard A. Proctor, B.A. (Cambridge).

In my treatise on the Sun I have pointed out at page 192 that the conspicuous nature of the darkening of the disk near the edge is a proof of the shallowness of the superincumbent atmosphere, and not, as is commonly stated, of that atmosphere's being enormously deep. And at p. 295 I indicate reasons for believing that the method by which the prominences and sierra have been studied when the Sun is not eclipsed, is not capable (save under highly exceptional conditions) of exhibiting the existence of the true solar atmosphere,—that atmosphere, to wit, which causes the dark lines in the solar spectrum.

It will be known to all who read this communication that Professor Young, of America, and Mr. Pye, independently recognised the existence of a highly complex atmosphere close by the solar photosphere. The slit of a spectroscope being placed tangentially to the limb, at the place where second contact was to occur, the spectroscopic field at the moment of totality and for several seconds after, was seen to be full of bright lines, "every non-atmospheric line of the solar spectrum showing bright."

The accuracy of this observation has been called in question. It is urged that the method of observing the uneclipsed Sun should be competent to show these bright lines if the supposed atmosphere have a real existence.

Now the competence of the last-mentioned method, so far as its power of obviating the effects of atmospheric illumination is concerned, cannot be questioned. For, indeed, as we know, Mr. Lockyer has, on one occasion, seen multitudes of the Fraunhofer lines reversed in this way. But because he has on all other occasions failed, while neither Zöllner, Respighi, nor Young has been favoured even with a single view of this sort, it is urged that no such atmosphere can exist, or that, at any rate, eclipse observers could have no better opportunity of recognising it with the spectroscope than those who have studied the uneclipsed Sun. I